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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

NEEDLE & ROSENBERG, P.C.
Suite 1200, The Candler Building
127 Peachtree Street, N.E.
Atlanta, Georgia 30303-1811

June 9, 2000

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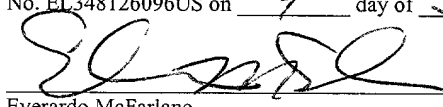
Dear Sir:

Transmitted herewith for filing are the specification and claims of the utility patent application of:

Inventor(s): Joseph W. Fikes, Anthony F. Zwilling, Christopher S. Anderson,
Michael C. Zari

Title of Invention: TARGET SCORING SYSTEM

Also enclosed are:

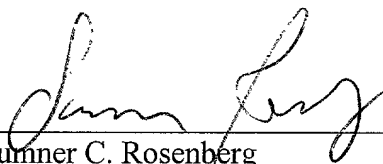
4	SHEETS OF	<input checked="" type="checkbox"/> FORMAL DRAWINGS	<input type="checkbox"/> INFORMAL DRAWINGS
X	OATH OR DECLARATION OF APPLICANT(S)		
X	A POWER OF ATTORNEY		
	A PRELIMINARY AMENDMENT		
	A VERIFIED STATEMENT TO ESTABLISH SMALL ENTITY STATUS UNDER 37 C.F.R. §1.9 AND §1.27		
X	A CHECK IN THE AMOUNT OF \$900.00 TO COVER THE FILING FEE.		
X	THE COMMISSIONER IS HEREBY AUTHORIZED TO CHARGE ANY ADDITIONAL FEES WHICH MAY BE REQUIRED IN CONNECTION WITH THE FOLLOWING OR CREDIT ANY OVERPAYMENT TO ACCOUNT NO. 14-0629		
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X	I hereby certify that this correspondence is being placed in the United States Mail as Express Mail No. EL348126096US on <u>9</u> day of <u>JUNE</u> , 2000.  Everardo McFarlane DATE <u>6-9-2000</u>		
	A computer readable form of the sequence listing in compliance with 37 C.F.R. § 1.821(e). The content of the computer readable form of the sequence listing and the sequence listing in the specification of the application as filed are the same.		
X	OTHER (IDENTIFY): A Microfiche Appendix comprising 5 fiches and 267 frames		

The filing fee is calculated as follows:

CLAIMS AS FILED, LESS ANY CLAIMS CANCELLED BY AMENDMENT

TOTAL CLAIMS = $23 - 20 = 3 \times \$18.00 =$	\$54.00
INDEPENDENT CLAIMS = $5 - 3 = 2 \times \$78.00 =$	\$156.00
BASIC FEE =	\$690.00
TOTAL OF ABOVE CALCULATIONS =	\$900.00
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Respectfully submitted,


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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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09/590919
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In re Application of)	
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Fikes et al.)	
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Serial No. Unassigned)	Group Art Unit: Unassigned
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Filed: Concurrently)	Examiner: Unassigned
)	
For: TARGET SCORING SYSTEM)	

**AUTHORIZATION TO TREAT REPLY REQUIRING EXTENSION OF TIME
AS INCORPORATING PETITION FOR EXTENSION OF TIME**

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

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Suite 1200, The Candler Building
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Atlanta, Georgia 30303-1811

June 9, 2000

Sir:

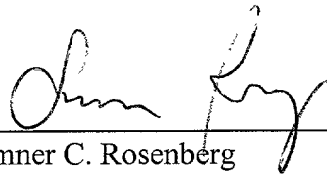
Pursuant to 37 C.F.R. §1.136(a)(3), the Commissioner is hereby requested and authorized to treat any concurrent or future reply in the above-identified application, requiring a petition for an extension of time for its timely submission, as incorporating a petition for extension of time for the appropriate length of time.

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The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 14-0629.

Respectfully submitted,

NEEDLE & ROSENBERG, P.C.

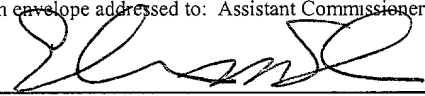

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Everardo McFarlane

Date

6-9-2000

5

10

15 TO ALL WHOM IT MAY CONCERN:

Be it known that we, **Joseph W. Fikes**, having a post office address and a residence address at 6817 Criner Rd. SE, Huntsville, AL 35802, a citizen of the United States; **Anthony F. Zwillling**, having a post office address and a residence address at 112 Rachel Dr., Huntsville, AL 35806, a citizen of the United States; **Christopher S. Anderson**, having a post office address and a residence address at 4556 Knollwood Lane, Niceville, FL 32578, a citizen of the United States; and **Michael C. Zari**, having a post office address and a residence address at 123 Sunscape Dr., Huntsville, AL 35806, a citizen of the United States, have invented new and useful improvements in a

TARGET SCORING SYSTEM

for which the following is a specification.

TARGET SCORING SYSTEM

BACKGROUND OF THE INVENTION

5 REFERENCE TO MATERIAL SUBJECT TO COPYRIGHT PROTECTION

A portion of the disclosure of this patent document contains material which is subject to copyright protection. The copyright owner has no objection to the facsimile reproduction by anyone of the patent disclosure, as it appears in the Patent and Trademark Office patent files or records, but otherwise reserves all copyrights
10 whatsoever.

REFERENCE TO A MICROFICHE APPENDIX

A microfiche appendix containing program source code used in one embodiment of the invention schematic diagrams of one embodiment of a circuit
15 employed in data capture is submitted herewith. The microfiche comprises 5 fiches and 267 frames.

1. Field of the Invention

20 The present invention relates to locating systems and, more specifically, to a system for scoring projectiles fired at a target.

2. Description of the Prior Art

25 Current small arms scoring systems use various techniques to measure impact coordinates and velocity information relating to small arms projectiles. With the acoustic technique, acoustic targets measure a shock wave produced by a high speed projectile. By measuring the time of acoustic impact at the four corners of a target, accurate change locations may be obtained. This technique has a
30 disadvantage in that it is sensitive to environmental changes such as changes in

temperature, pressure and humidity. This technique also does not work with sub-sonic projectiles.

The impact spark technique relies on having a material in the target area that
5 facilitates optical detection of impact points. This technique has the disadvantage of being difficult to operate outside due to ambient light.

The high speed charge coupled device (CCD) imaging technique images a target area and detects scattered light reflected off of a projectile using a CCD
10 camera. This technique has a disadvantage in that different projectile surface types lead to different inconsistency in light reflection.

Therefore, there is a need for a target scoring system that is immune to environmental changes and that is accurate irrespective of such variables as ambient
15 light and projectile surface type.

SUMMARY OF THE INVENTION

The disadvantages of the prior art are overcome by the present invention
20 which, in one aspect, is a device for target scoring that includes an elongated retro-reflective member, a first light source, a second light source, a first light sensor, a second light sensor and a processor. The first light source is disposed at a first location and is spaced apart from the retro-reflective member. The first light source is also positioned so as to be able to direct a first beam of light toward the retro-
25 reflective member. The second light source is disposed at a second location spaced apart from both the retro-reflective member and from the first light source. The second light source is also positioned so as to be able to direct a second beam of light toward the retro-reflective member so that the second beam of light intersects the first beam of light over an area so as to define a target area. The first light sensor

is disposed adjacent the first light source and is positioned so as to be able to receive light from the first light source that has been reflected from the retro-reflective member. The first light sensor generates a first signal indicative of a first position of a first object sensed by blockage of illumination from the retro-reflective member.

- 5 The second light sensor is disposed adjacent the second light source and is positioned so as to be able to receive light from the second light source that has been reflected from the retro-reflective member. The second light sensor generates a second signal indicative of a second position of a second object sensed by blockage of illumination from the retro-reflective member. The processor is responsive the
- 10 first signal and to the second signal and is programmed to determine a location of the object in the target area, based on the first position of the first shadow and the second position of the second shadow.

- In another aspect, the invention is a device for target scoring that includes an
- 15 elongated lamp having a first end and a second end. A first light sensor is spaced apart from the elongated lamp and is disposed so as to be able to receive light from every point along a first portion of the elongated lamp. The first light sensor is also capable of detecting a blockage of light from a second portion of the elongated lamp. The first light sensor generates a first signal indicative of an angular position of the
- 20 blockage relative to a predetermined axis. A second light sensor is spaced apart from the elongated lamp and from the first light sensor. The second light sensor is disposed so as to be able to receive light from every point along the first portion of the elongated lamp and is capable of detecting the blockage of light from the second portion of the elongated lamp. The second light sensor generates a second signal
- 25 indicative of an angular position of the blockage relative to the predetermined axis. A processor that is responsive the first signal and to the second signal is programmed to determine a location of the object, based on the angular position of the blockage.

In yet another aspect, the invention is a method of determining a location of an object. A first beam of light from a first light source is directed toward a retro-reflective member. A second beam of light from a second light source is directed toward the retro-reflective member. A position of a first shadow cast by the object
5 onto the retro-reflective member as it is illuminated by the first beam is determined. A position of a second shadow cast by the object onto the retro-reflective member as it is illuminated by the second beam is determined. The location of the object is determined by determining the point where a line from the first light source to the first shadow intersects a line from the second light source to the second shadow.

10
These and other aspects of the invention will become apparent from the following description of the preferred embodiments taken in conjunction with the following drawings. As would be obvious to one skilled in the art, many variations and modifications of the invention may be effected without departing from the spirit
15 and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWINGS

FIG. 1 is a schematic diagram of one embodiment of the invention.

FIG. 2A is a schematic diagram of a camera/light device employed in the embodiment of FIG. 1.

FIG. 2B is a front elevation of the reflector shown in FIG. 2A.

FIG. 2C is a perspective view of the reflector shown in FIG. 2B.

FIG. 3 is a schematic diagram of a second embodiment of the invention.

FIG. 4 is a schematic diagram of a third embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment of the invention is now described in detail. Referring to the drawings, like numbers indicate like parts throughout the views. As used in the description herein and throughout the claims, the following terms take the meanings explicitly associated herein, unless the context clearly dictates otherwise: the meaning of “a,” “an,” and “the” includes plural reference, the meaning of “in” includes “in” and “on.”

As shown in FIG. 1, in one embodiment the invention is a target scoring device **100** that includes a frame **110** that supports an elongated retro-reflective member **112** which, in the example shown, includes a first reflective surface **114** disposed on a first plane and a second reflective surface **116** disposed on a second plane that intersects the first plane. As used herein, retro-reflective means having the ability to reflect a ray of light substantially in the direction of its source. The elongated retro-reflective member **112** could be made from retro-reflective tape (such as retro-reflective tape that includes a surface upon which is deposited a plurality of glass beads - as is typically used in manufacturing traffic signs) or even a plurality of corner reflectors.

A first light source/sensor unit **120** is disposed at a first location on the frame **110** opposite from the first reflective surface **112**. The first light source/sensor unit **120** is positioned so as to be able to direct a first beam **122** of light toward the first reflective surface **114** and to receive a reflection of the first beam **122** from the first reflective surface **114**. The first light source/sensor unit **120** generates a first signal **154** that indicates the position of an object **146** (such as a projectile) viewed against the first reflective surface **114** illuminated by the first beam **122**.

A second light source/sensor unit **130** is disposed at a second location on the frame **110** opposite from the second reflective surface **116**. The second light source/sensor unit **130** is positioned so as to be able to direct a second beam **132** of

light toward the second reflective surface **116** and to receive a reflection of the second beam **132** from the second reflective surface **116**. The second light source/sensor unit **130** generates a second signal **156** that indicates the position of an object **146** viewed against the second reflective surface **116** illuminated by the
5 second beam **132**.

The first beam **122** intersects the second beam **132** in an overlap area **140** that defines a target area **142**. An actual target **144** may be placed behind the target area **142**, so as not to block the first beam **122** or the second beam **132**, thereby
10 providing a visual reference. When one shoots at the target, the projectile **146**, in going to the target **144** passes through the target area **142** and, thus, blocks a portion of the illumination from the first reflective surface **114** and the second reflective surface **116**, respectively. The beams **122** and **132** are reflected back to the source/sensor units **120** and **130**, respectively. The source/sensor units **120** and **130**
15 then generate the first and second signals **154** and **156** indicative of the positions of the projectile **146** as viewed against the reflective surfaces **114** and **116**, respectively.

A processor **150** is responsive the first signal and to the second signal and is
20 programmed to determine a location of the object **146** in the target area **142**, based on the views of the object **146** as sensed by the source/sensor units **120** and **130**. The processor **150** includes a computer **160** and an electronic interface **152** (which may be embedded in the computer as an interface card). The interface **152** conditions the first and second signals **154** and **156** so as to be readable by the
25 computer **160** and delivers a digital signal **162** (or combination of digital signals) that provides the computer **160** with a digital representation of the first and second signals **154** and **156**. From the information in the digital signal **162**, the computer **160** calculates the position of the object **146** relative to the target **144** and displays a virtual image of the projectile **166** on a virtual image of a target **164**. This
30 information may also be stored for later analysis.

In one embodiment, the processor **150** is essentially self-triggered by comparing successive data frames from the sensor unit **120**. When a data frame is sensed having data that comports with an object **146** passing through the target area **142**, the processor **150** begins processing data received from the sensors.

5

The computer **160** may be further programmed to ignore objects passing in the target area **142** at less than the velocity of an expected projectile. This would include situations in which, for example, an insect or a bird flies through the target area **142**. By determining the amount of time that the object remains in the target area **142**, the computer **160** can reject data corresponding to objects remaining longer than would be expected if the object **146** were a projectile. Similarly, the system can reject data corresponding to objects having dimensions different from that of an expected projectile. For example, a bird would have a greater diameter than that of a .45 caliber bullet. Therefore, if the system senses an illumination blockage corresponding to that of a bird, any data collected would be ignored. In this way, only meaningful data is displayed.

As shown in FIGS. 2A, 2B and 2C, a source/sensor unit **200** includes a box **206**, opening on one side to a protective window **204**, that houses an electronic camera **210** and an illumination unit **220**. The electronic camera **210** is of the type that can capture an image of a projectile passing through a defined area. In one embodiment, the electronic camera **210** is a camera employing a charge coupled device (CCD) optical sensor.

The illumination unit **220** includes a reflector **222**, a light source **224** and a deflector **230**. The light source **224** could comprise an incandescent light bulb (for example, a 300W quartz halogen bulb in one embodiment) or a laser. The reflector **222** is of the type that focuses light so as to form a fan beam that runs parallel to a central axis **226** in one dimension. In the embodiment shown, the reflector is made from a block of aluminum **232** with a parabolic curved reflective surface **222**. The curved reflective surface **222** has a radius of curvature and a distance from the light

source **224** so that light from the light source **224** is projected onto the retro-reflective surfaces **114**, **116**. Machined into the aluminum block **232** is an elongated slit **228**, spaced apart from the axis **226**, for allowing light reflected from the first and second reflective surfaces **114**, **116** to return to the electronic camera **210**, which
5 is placed coaxially with the slit **228**. The reflective surface **222** is nickel plated so as to increase reflectivity. The deflector **230** is placed along the central axis **226** between the light source **224** and the window **204** to prevent light from reflecting off of the window **204** directly into the electronic camera **210**. Although not shown in FIG. 2A, louvers could be added so as to extend from the window **204** to reduce the
10 probability that sunlight would enter the electronic camera **210** and confuse the results.

In another embodiment, as shown in FIG. 3, the invention includes an elongated lamp **320**, such as a fluorescent tube, having a first end **322** and a second
15 end **324**. A first light sensor **310a**, spaced apart from the elongated lamp **320**, is aimed so as to receive a first beam of light **330a** from the elongated lamp **320**. A second light sensor **310b**, spaced apart from the elongated lamp **320** and from the first light sensor **310a**, is also aimed so as to receive a first beam of light **330b** from the elongated lamp **320**. The area of overlap of the first beam **330a** and the second
20 beam **330b** defines the target area **342**. Signals from the first and second light sensors **330a** and **330b** are processed as described above with reference to FIG. 1 to detect a shadow of a projectile passing through the target area **342** and, thus, determine its location.

25 In yet another embodiment, as shown in FIG. 4, the projectile **446** may include a retro-reflective surface (e.g., such as a retro-reflective paint or tape applied to the projectile). Such an embodiment eliminates the need for the elongated retro-reflective members disclosed above. In such an embodiment, the processor is programmed to detect flashes of light corresponding to light reflections returning
30 from the projectile **446** to the source/sensor units **420**, **430**.

Prior to use, the CCD camera should be calibrated to determine which pixels correspond to each angular displacement relative to the camera. This may be done in a lab by aiming a point source of light (or a point blockage of light) at the camera and moving the point source along an arc at a plurality of known angles. The response of the camera is recorded for each angle. This data, stored in the form of a look-up table, or other data storage method, is then used by the computer to determine the angle of the projectile as a function of the pixel in the camera being blocked.

Calibration of the CCD cameras in the field can be accomplished by placing a long pole with three pins extending from the pole so that the three pins extend into the target area along an axis perpendicular to the axis of the CCD camera. The distance between each pin is a known quantity and the center pin on the pole is placed at the center of the target. The CCD camera detects each pin and the computer, employing the law of sines, determines the position of the CCD camera relative to the center pin.

The above described embodiments are given as illustrative examples only. It will be readily appreciated that many deviations may be made from the specific embodiments disclosed in this specification without departing from the invention. Accordingly, the scope of the invention is to be determined by the claims below rather than being limited to the specifically described embodiments above.

CLAIMS

What is claimed is:

1. A device for target scoring, comprising:
 - a. an elongated retro-reflective member;
 - b. a first light source disposed at a first location spaced apart from the retro-reflective member and positioned so as to be able to direct a first beam of light toward the retro-reflective member;
 - c. a second light source disposed at a second location spaced apart from both the retro-reflective member and from the first light source, the second light source positioned so as to be able to direct a second beam of light toward the retro-reflective member so that the second beam of light intersects the first beam of light over an area defining a target area;
 - d. a first light sensor, disposed adjacent the first light source and positioned so as to be able to receive light from the first light source that has been reflected from the retro-reflective member, that generates a first signal indicative of a first position of a first blockage of illumination from the retro-reflective member;
 - e. a second light sensor, disposed adjacent the second light source and positioned so as to be able to receive light from the second light source that has been reflected from the retro-reflective member, that generates a second signal indicative of a second position of a second blockage of illumination from the retro-reflective member; and
 - f. a processor responsive the first signal and to the second signal that is programmed to determine a location of the object in the target area, based on the first position of the first blockage of illumination and the second position of the second blockage of illumination.

2. The device of Claim 1, wherein the elongated retro-reflective member comprises a first reflective surface disposed on a first plane and a second reflective surface disposed on a second plane intersecting the first plane.
3. The device of Claim 1, wherein the elongated retro-reflective member comprises retro-reflective tape.
4. The device of Claim 1, wherein the elongated retro-reflective member comprises a plurality of corner reflectors.
5. The device of Claim 1, wherein the elongated retro-reflective member comprises a plurality of glass beads.
6. The device of Claim 1, wherein the processor is further programmed to ignore objects passing in the target area at less than a predetermined velocity.
7. The device of Claim 1, wherein the processor is further programmed to ignore objects having a cross-sectional diameter greater than a predetermined amount.
8. The device of Claim 1, wherein the processor is further programmed to ignore objects which are present within the target area for an amount of time that is greater than a first predetermined period or less than a second predetermined period.
9. The device of Claim 1, further comprising a frame upon which is mounted the retro-reflective member, the first light source, the second light source, the first light sensor, and the second light sensor.
10. The device of Claim 1, further comprising a structure that holds a target in a position corresponding to the target area.

11. The device of Claim 1, wherein the processor is programmed to generate a virtual image of the object relative to its position in the target area.
12. The device of Claim 11, wherein the processor is programmed to generate a virtual image of a target.
13. The device of Claim 1, wherein the first light source and the second light source each comprise an incandescent lamp.
14. The device of Claim 1, wherein the first light source and the second light source each comprise a laser.
15. The device of Claim 1, wherein the first light sensor and the second light sensor each comprise a charge coupled device camera.
16. The device of Claim 1, wherein the first light source and the second light source each comprises:
 - a. an light bulb; and
 - b. a curved mirror, disposed adjacent the light bulb, having a radius of curvature and a distance from the light bulb so that light from the light bulb is projected onto the retro-reflective surface.
17. The device of Claim 16, wherein the light bulb is an incandescent light bulb.
18. The device of Claim 16, wherein the curved mirror has an axis of curvature, the light bulb being disposed along the axis of curvature, and wherein the curved mirror defines an elongated slit that is parallel to and spaced apart from the axis of curvature.

19. The device of Claim 18, wherein each light sensor is disposed adjacent the curved mirror opposite from the light bulb and coaxial with the elongated slit so that light from the retro-reflector is received by the light sensor through the elongated slit.
20. A device for target scoring, comprising:
- a. an elongated lamp having a first end and a second end;
 - b. a first light sensor, spaced apart from the elongated lamp and disposed so as to be able to receive light from every point along a first portion of the elongated lamp and capable of detecting a blockage of light from a second portion of the elongated lamp, the first light sensor generating a first signal indicative of an angular position of the blockage relative to a predetermined axis;
 - c. a second light sensor, spaced apart from the elongated lamp and from the first light sensor, disposed so as to be able to receive light from every point along the first portion of the elongated lamp and capable of detecting the blockage of light from the second portion of the elongated lamp, the second light sensor generating a second signal indicative of an angular position of the blockage relative to the predetermined axis; and
 - d. a processor responsive the first signal and to the second signal that is programmed to determine a location of the object in a target area, based on the angular position of the blockage.
21. A method of determining a location of an object, comprising the steps of:
- a. directing a first beam of light from a first light source toward a retro-reflective member;
 - b. directing a second beam of light from a second light source toward the retro-reflective member;
 - c. determining a position of a first shadow cast by the object onto the retro-reflective member as it is illuminated by the first beam;

- d. determining a position of a second shadow cast by the object onto the retro-reflective member as it is illuminated by the second beam; and
 - e. determining the location of the object by determining the point where a line from the first light source to the first shadow intersects a line from the second light source to the second shadow.
22. An apparatus for determining a location of an object, comprising the steps of:
- a. means for directing a first beam of light from a first light source toward a retro-reflective member;
 - b. means for directing a second beam of light from a second light source toward the retro-reflective member;
 - c. means for determining a position of a first blockage of illumination from the retro-reflective member as it is illuminated by the first beam by an object;
 - d. means for determining a position of a second blockage of illumination from the retro-reflective member as it is illuminated by the second beam by the object; and
 - e. means for determining the location of the object by determining the point where a line from the first sensor to the first blockage of illumination intersects a line from the second sensor to the second blockage of illumination.
23. An apparatus for determining a location of an object having a retro-reflective outer surface, comprising the steps of:
- a. means for directing a first beam of light from a first light source toward the object;
 - b. means for directing a second beam of light from a second light source toward the object;
 - c. means for determining a position of a first reflection from the object as it is illuminated by the first beam;

- d. means for determining a position of a second reflection from the object as it is illuminated by the second beam; and
- e. means for determining the location of the object by determining the point where a line from the first light source to the first reflection intersects a line from the second light source to the second reflection.

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ABSTRACT

A device for target scoring includes an elongated retro-reflective member, a first light source, a second light source, a first light sensor, a second light sensor and a processor. The first light source is disposed at a first location and is spaced apart from the retro-reflective member. The first light source is also positioned so as to be able to direct a first beam of light toward the retro-reflective member. The second light source is disposed at a second location spaced apart from both the retro-reflective member and from the first light source. The second light source is also positioned so as to be able to direct a second beam of light toward the retro-reflective member so that the second beam of light intersects the first beam of light over an area so as to define a target area. The first light sensor is disposed adjacent the first light source and is positioned so as to be able to receive light from the first light source that has been reflected from the retro-reflective member. The first light sensor generates a first signal indicative of a first position of a first blockage of illumination from the retro-reflective member. The second light sensor is disposed adjacent the second light source and is positioned so as to be able to receive light from the second light source that has been reflected from the retro-reflective member. The second light sensor generates a second signal indicative of a second position of a second blockage of illumination from the retro-reflective member. The processor is responsive to the first signal and to the second signal. The processor is programmed to determine a location of the object in the target area, based on the first position of the first blockage of illumination and the second position of the second blockage of illumination.

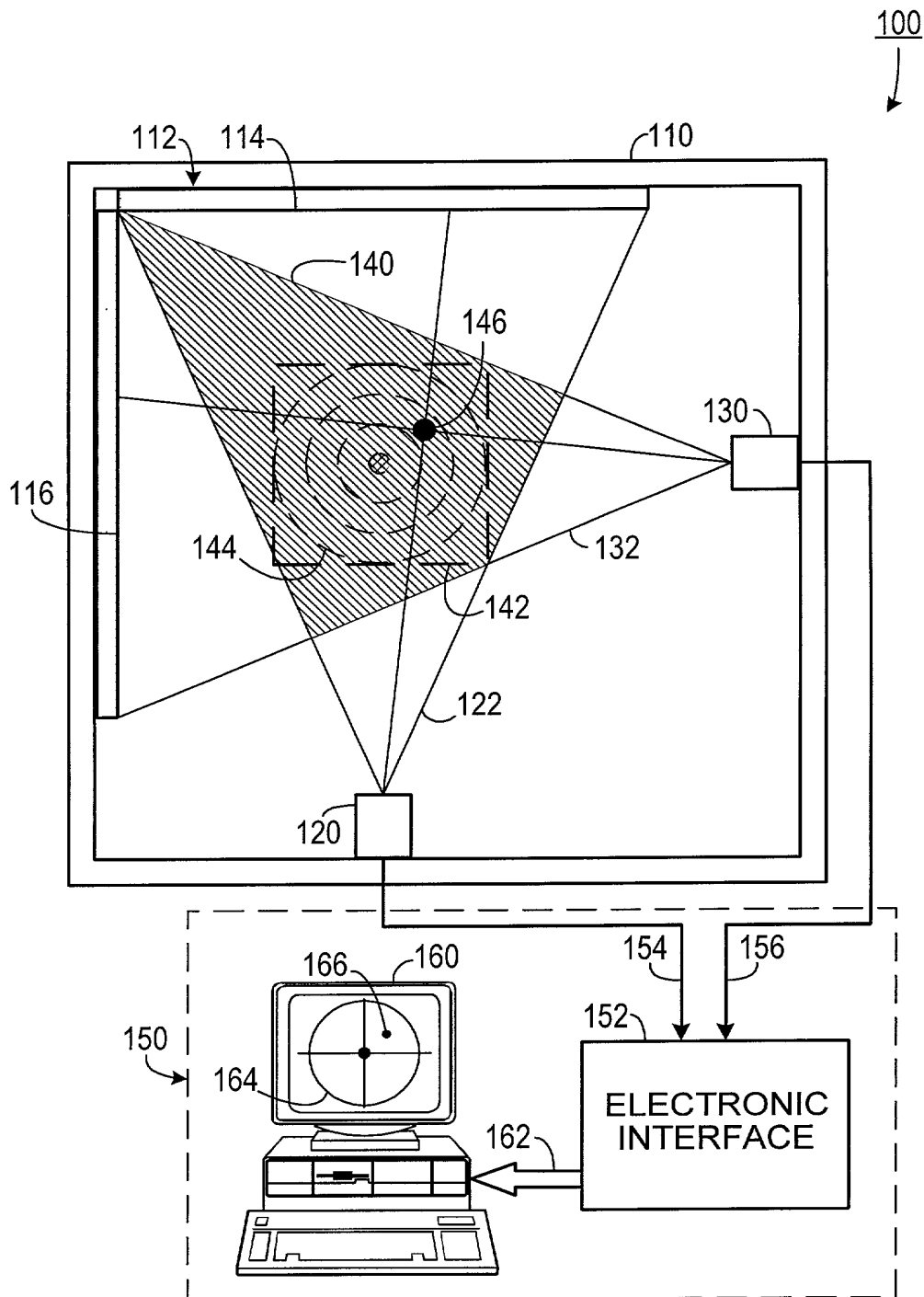


FIG. 1

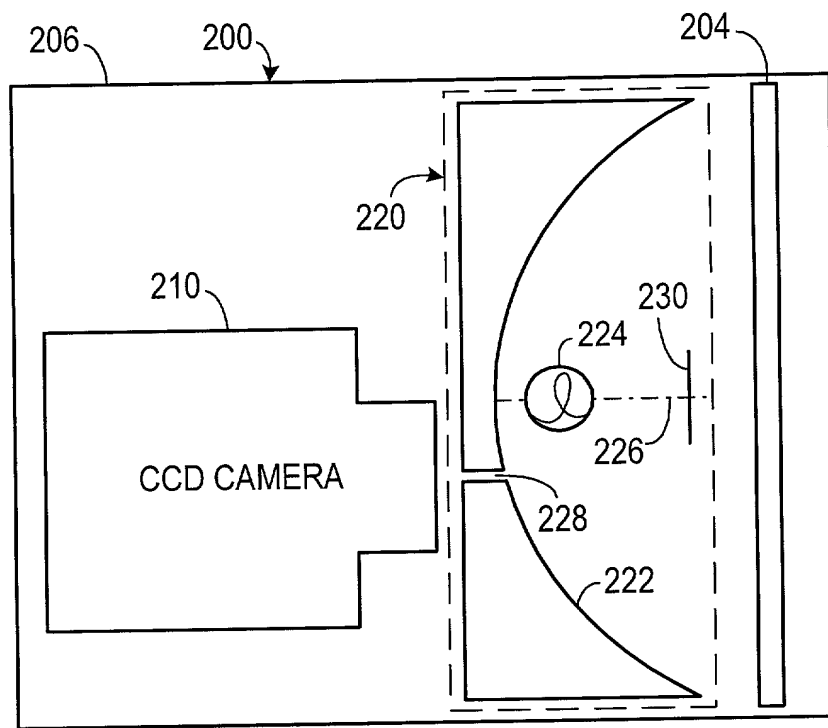


FIG. 2A

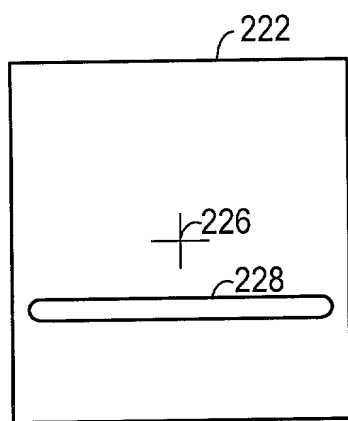


FIG. 2B

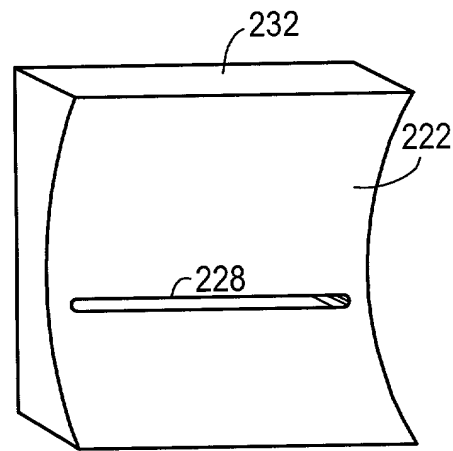


FIG. 2C

Variable	Mean	SD	Min	Max
Age	34.5	10.2	21	55
Gender	0.45	0.50	0	1
Marital Status	0.65	0.48	0	1
Education	12.5	1.5	9	16
Income	2500	1500	500	6000
Health Status	0.75	0.43	0	1
Employment Status	0.85	0.36	0	1
Life Satisfaction	4.2	1.8	1	7
Stress Level	3.5	1.5	1	6
Quality of Life	5.5	2.0	2	8
Physical Health	6.0	1.5	3	9
Mental Health	5.0	2.0	2	8
Social Support	4.5	1.5	1	7
Life Expectancy	75.0	5.0	60	90
Healthcare Access	0.95	0.22	0	1
Health Insurance	0.80	0.40	0	1
Physical Activity	3.0	1.5	1	5
Diet Quality	4.0	1.0	2	5
Sleep Quality	3.5	1.0	2	5
Smoking Status	0.15	0.37	0	1
Alcohol Consumption	0.25	0.43	0	1
Chronic Disease	0.30	0.46	0	1
Genetic Risk	0.10	0.32	0	1
Environmental Risk	0.20	0.40	0	1
Healthcare Utilization	2.0	1.0	0	4
Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
Healthcare Access	0.90	0.29	0	1
Healthcare Quality	0.85	0.35	0	1
Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
Healthcare Access	0.90	0.29	0	1
Healthcare Quality	0.85	0.35	0	1
Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
Healthcare Access	0.90	0.29	0	1
Healthcare Quality	0.85	0.35	0	1
Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
Healthcare Access	0.90	0.29	0	1
Healthcare Quality	0.85	0.35	0	1
Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
Healthcare Access	0.90	0.29	0	1
Healthcare Quality	0.85	0.35	0	1
Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
Healthcare Access	0.90	0.29	0	1
Healthcare Quality	0.85	0.35	0	1
Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
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Healthcare Costs	1000	500	200	2500
Healthcare Satisfaction	4.0	1.5	1	7
Healthcare Access	0.90	0.29	0	1
Healthcare Quality	0.85	0.35	0	

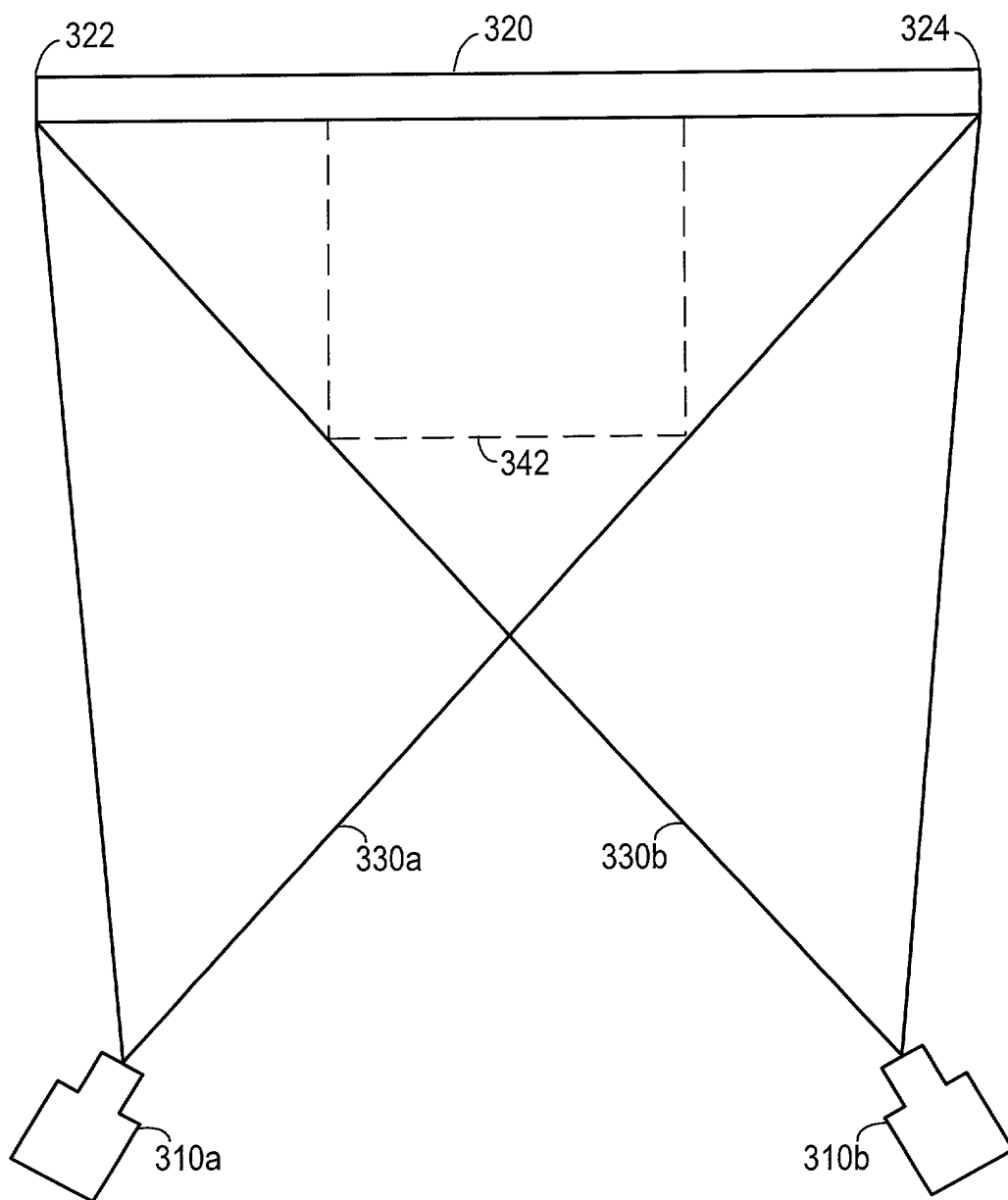


FIG. 3

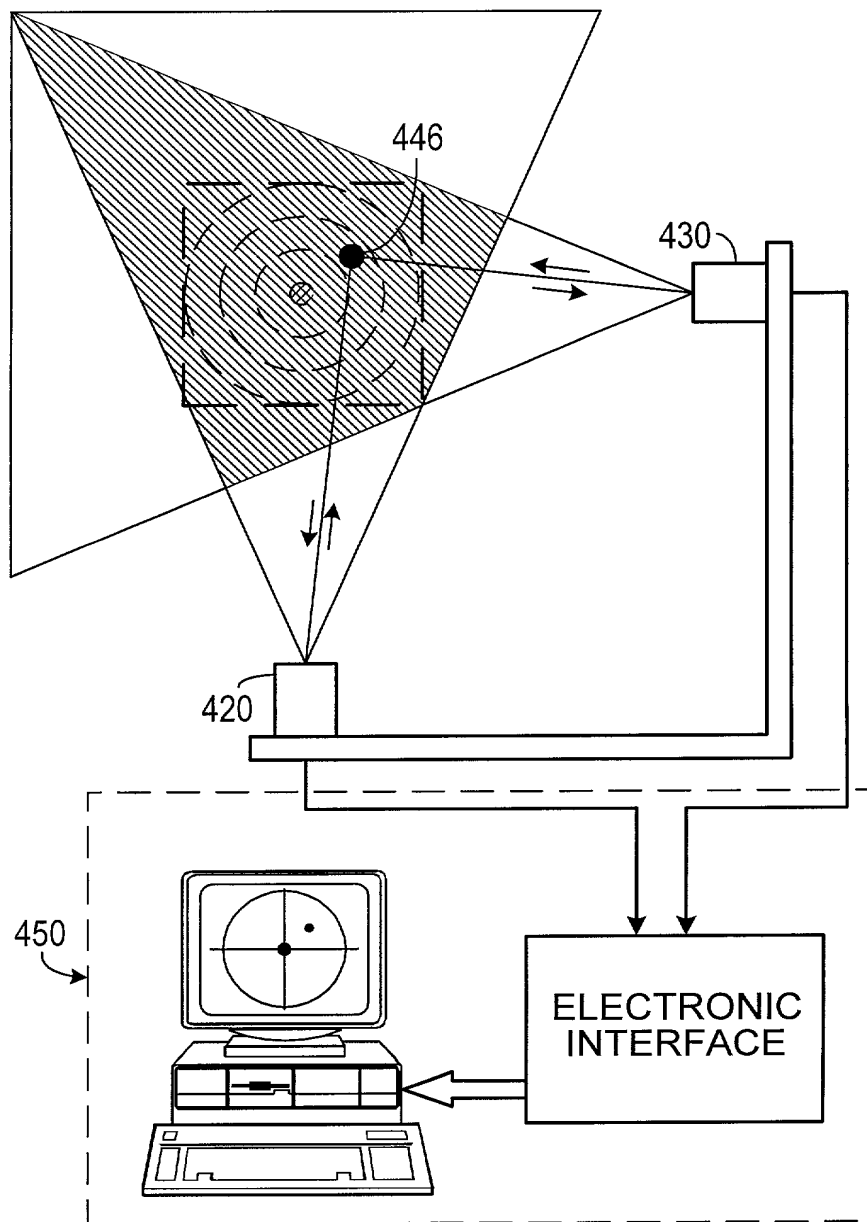


FIG. 4

(X) Original () Supplemental () Substitute () PCT

My residence, post office address and citizenship are as stated below next to my name.

(check one) ☒ which is attached hereto, or
 ☐ which was filed on , as United States Application No. and with
 amendments through (if applicable), or
 ☐ in International Application No. PCT/, filed , and as amended on
 (if applicable).

I acknowledge the duty to disclose all information known by me to be material to the patentability of the claims of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a) - (d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate relating to this subject matter having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATIONS: (ENTER BELOW IF APPLICABLE)			PRIORITY CLAIMED (MARK APPROPRIATE BOX BELOW)	
APP. NUMBER	COUNTRY	DAY/MONTH/YEAR FILED	YES	NO
N/A				

W032605

APPLICATION NUMBER	FILING DATE
N/A	

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information known by me to be material to the patentability of the claims of this application as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	FILING DATE	STATUS (MARK APPROPRIATE COLUMN BELOW)		
		PATENTED	PENDING	ABANDONED
N/A				

I hereby appoint the following attorneys and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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ATTORNEY DOCKET NO. 04026.0013

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of first inventor: **Joseph W. Fikes**

Inventor's signature: Joseph W. Fikes Date: 4/5/2000
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 Post Office Address: 6817 Criner Rd. SE, Huntsville, AL 35802
 Citizenship: USA

Full name of second inventor: **Anthony F. Zwilling**

Inventor's signature: Anthony F. Zwilling Date: 2000/05/04
 Residence: 112 Rachel Dr., Huntsville, AL 35806
 Post Office Address: 112 Rachel Dr., Huntsville, AL 35806
 Citizenship: USA

Full name of third inventor: **Christopher S. Anderson**

Inventor's signature: _____ Date: _____
 Residence: 4556 Knollwood Lane, Niceville, FL 32578
 Post Office Address: 4556 Knollwood Lane, Niceville, FL 32578
 Citizenship: USA

Full name of fourth inventor: **Michael C. Zari**

Inventor's signature: _____ Date: _____
 Residence: 123 Sunscape Dr., Huntsville, AL 35806
 Post Office Address: 123 Sunscape Dr., Huntsville, AL 35806
 Citizenship: USA

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of first inventor: **Joseph W. Fikes**

Inventor's signature: _____ Date: _____
 Residence: 6817 Criner Rd. SE, Huntsville, AL 35802
 Post Office Address: 6817 Criner Rd. SE, Huntsville, AL 35802
 Citizenship: USA

Full name of second inventor: **Anthony F. Zwilling**

Inventor's signature: _____ Date: _____
 Residence: 112 Rachel Dr., Huntsville, AL 35806
 Post Office Address: 112 Rachel Dr., Huntsville, AL 35806
 Citizenship: USA

Full name of third inventor: **Christopher S. Anderson**

Inventor's signature: *Christopher S. Anderson* Date: 5-26-00
 Residence: 4556 Knollwood Lane, Niceville, FL 32578
 Post Office Address: 4556 Knollwood Lane, Niceville, FL 32578
 Citizenship: USA

Full name of fourth inventor: **Michael C. Zari**

Inventor's signature: _____ Date: _____
 Residence: 123 Sunscape Dr., Huntsville, AL 35806
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Full name of first inventor: **Joseph W. Fikes**

Inventor's signature: _____ Date: _____
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Citizenship: USA

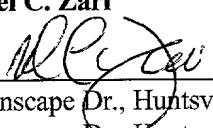
Full name of second inventor: **Anthony F. Zwilling**

Inventor's signature: _____ Date: _____
Residence: 112 Rachel Dr., Huntsville, AL 35806
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Full name of third inventor: **Christopher S. Anderson**

Inventor's signature: _____ Date: _____
Residence: 4556 Knollwood Lane, Niceville, FL 32578
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Citizenship: USA

Full name of fourth inventor: **Michael C. Zari**

Inventor's signature:  _____ Date: 4/20/00
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Post Office Address: 123 Sunscape Dr., Huntsville, AL 35806
Citizenship: USA

ATTORNEY DOCKET NO. 04026.0013

_____(L.S.)
Christopher S. Anderson

State of _____

County of _____

On this _____ day of _____, 1999, before me, a Notary Public, came **Christopher S. Anderson**, to me known and known to be the individual described in and who executed the foregoing assignment, and he duly acknowledged the same to be his free act and deed.

Notary Public _____

My Commission Expires: _____

_____(L.S.)
Michael C. Zari

State of _____

County of _____

On this _____ day of _____, 1999, before me, a Notary Public, came **Michael C. Zari**, to me known and known to be the individual described in and who executed the foregoing assignment, and he duly acknowledged the same to be his free act and deed.

Notary Public _____

My Commission Expires: _____